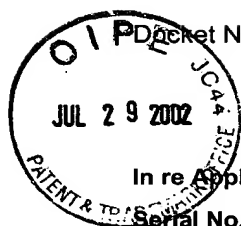


07/31/02

2815



Docket No.: D412

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Kai Yang et al.

Confirmation No.: 1824

Serial No.: 09/663,021

Examiner: Sheila V. Clark

Filed: Sep 15, 2000

Group Art Unit: 2815

For:

SELF-ALIGNED SEMICONDUCTOR
INTERCONNECT BARRIER AND
MANUFACTURING METHOD
THEREFOR

TRANSMITTAL FOR ENCLOSURES (check all that apply)

<input checked="" type="checkbox"/> Response / Amendment <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/Declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input type="checkbox"/> Information Disclosure Statement, PTO Form-1449, & cited Reference(s) <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Response to Missing Parts/Incomplete Application <input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Assignment Papers (for an Application) <input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Power of Attorney, Revocation Change of Correspondence Address <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Request for Refund	<input type="checkbox"/> After Allowance Communication to Group <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to Group (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input checked="" type="checkbox"/> Other Enclosure(s) (please identify below): Return Acknowledgement Postcard
Remarks		

The fee, if required, has been calculated as shown below:

	NO. OF CLAIMS	HIGHEST PREVIOUSLY PAID FOR	EXTRA CLAIMS	RATE	FEE
Total Claims	18	20	0	x \$18 =	\$ 0.00
Independent Claims	3	3	0	x \$84 =	\$ 0.00
If multiple claims newly presented, add \$280					
Fee for extension of time					
TOTAL FEE					\$0.00

- ☐ Please charge Deposit Account No. 01-0365 in the amount of \$ 0.00. An additional copy of this transmittal sheet is submitted herewith.
- ☒ The Commissioner is hereby authorized to charge payment of any fees associated with this communication or credit any overpayment, to Deposit Account No. 01-0365, including any filing fees under 37 CFR 1.16 for presentation of extra claims and any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,

Mikio Ishimaru
Registration No. 27,449
Date: July 29, 2002

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Type or printed name	Vickie Ishimaru		
Signature		Date	July 29, 2002

Docket No.: D412
Express Mail Label No.: EV025380865US

H/S response
PATENT *8/7/02*
Shm ts

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Kai Yang, et al. : Confirmation No.: 1824
Serial No.: 09/663,021 : Art Unit: 2815
Filed: 9/15/2000 : Examiner: Sheila V. Clark
For: SELF-ALIGNED
SEMICONDUCTOR
INTERCONNECT
BARRIER AND
MANUFACTURING
METHOD THEREFOR

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RESPONSE

Sir:

The following Remarks are submitted in response to the Office Action mailed 5/29/2002.

REMARKS

Claim Rejections - 35 USC §102

Claims 1-4, 7-10, and 13-16 are rejected under 35 USC §102(a) as being anticipated by Zhao et al. (USPN 6,100,184, hereinafter "Zhao").

With regard to claims 1-4, Applicants respectfully traverse the rejections since the Applicants' claimed combination, as exemplified in claim 1, includes the limitation not disclosed in Zhao of:

"a second barrier layer disposed over said conductive layer in said channel, said second barrier layer of a metallic barrier material, whereby said conductive material is totally enclosed in metallic barrier material."
(underlining added)

The above indicates that the second barrier layer is in the second channel, which means the second barrier layer acts like a plug to prevent electromigration from the conductive layer.

Zhao discloses that the "etching or polishing step removes the excess metal material above the surface of the structure" and then the "encapsulation layer 34 is selectively formed above the exposed copper in order to fully encapsulate the copper" (Col. 10, lines 11-15). As is shown in FIG. 16 of Zhao, the resulting encapsulation layer 34 is not self-aligned and is located above the level of the channel defined in the ILD layer 18. Thus, Zhao discloses a cap over the Zhao channel, which would permit conductor material electromigration and/or diffusion.

In contrast, the second barrier layer in the Applicants' invention acts as a plug located inside the channel to plug, or prevent, conductor material electromigration and/or diffusion. In the Applicants' Specification, the conductive layer is referred to as the "recessed first channel 201" which has its surface "etched back or recessed to reduce its height by a 'predetermined' thickness" (Specification page 5, lines 27-29). Subsequently, the second barrier layer is deposited over the recessed first channel 201 and a CMP process removes excess barrier material so that the second barrier layer "fills the etch back recess" (Specification page 6, lines 25-26). Thus, the Applicants' second barrier layer is a self-aligned plug, filling the channel instead of resting on top. Because of this, the problem of diffusion at the interface between the first and second barrier layers that would be present in Zhao is solved in the Applicants' invention.

The dependent claim 2 depends from independent claim 1 and is believed to be allowable since it contains all the limitations set forth in the independent claim from which it depends and claims nonobvious combinations thereof including a first barrier layer of a metallic barrier material selected from a group of specified materials.

The dependent claim 3 depends from independent claim 1 and is believed to be allowable since it contains all the limitations set forth in the independent claim from which it depends and claims nonobvious combinations thereof including a second barrier layer of a metallic barrier material selected from a group of specified materials.

The dependent claim 4 depends from independent claim 1 and is believed to be allowable since it contains all the limitations set forth in the independent claim from which it

depends and claims nonobvious combinations thereof including a conductive material selected from a group of specified materials.

With regard to claims 7-10 and 13-16, the Examiner states that "the steps of providing, forming, removing, and depositing are deemed to be inherently taught by Zhao et al" based upon the structure shown in Zhao. As was explained with reference to claim 1 above, Zhao's structure teaches away from the Applicants' invention, as the second barrier layer in Zhao is above the channel instead of in the channel as disclosed in the Applicants' invention. It follows therefore, that the steps of providing, forming, removing, and depositing the structure in the Applicants' invention is patentably distinct from Zhao.

In particular, the Applicants' claimed combination, as exemplified in claim 7, includes the limitations not disclosed in Zhao of:

"removing a portion of said conductive layer inside said opening; and forming a second barrier layer over said conductive layer in said opening..." (underlining added)

From the above, there can be seen to be two limitations not disclosed in Zhao: a first limitation with the additional step of "removing a portion of said conductive layer inside said opening", and a second limitation of deposition into the opening.

Zhao does not teach or suggest the first limitation of removing conductive layer inside the opening. As shown in Zhao FIG. 16, there is no portion of the conductive layer that is removed from inside the opening. Further, there is no disclosure in the specification of Zhao of any process that removes any portion of the conductive layer from inside the opening.

Zhao specifically teaches away from the second limitation of deposition into the opening. Zhao's specification teaches using techniques "to selectively deposit" the second barrier layer "atop the exposed metal region" (column 10, lines 19-21). The deposition process atop the exposed metal region requires accurate location and alignment.

In marked contrast, the Applicants' patent uses, as the title, a "Self-Aligned Semiconductor Interconnect Barrier Layer...", suggests, a self-aligned deposition process which deposits the second barrier layer into the opening rather than atop it. The essence of the barrier being self-aligned requires that a portion of the conductive layer from inside the opening be removed, and that the formation of the second barrier layer be inside the opening as specified in the above claim.

Thus, the steps of providing, forming, removing, and depositing of the Applicants' claims 7-10, 13-16 are not believed to be inherent in Zhao.

The dependent claims 8 and 14 respectively depend from independent claims 7 and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim nonobvious combinations thereof including a first barrier layer of a metallic barrier material selected from a group of specified materials.

The dependent claims 9 and 15 respectively depend from independent claims 7 and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim nonobvious combinations thereof including a second barrier layer of a metallic barrier material selected from a group of specified materials.

The dependent claims 10 and 16 respectively depend from independent claims 7 and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim nonobvious combinations thereof including a conductive material selected from a group of specified materials.

Claim Rejections - 35 USC §103

Claims 5, 6, 11, 12, 17, and 18 are rejected under 35 USC §103(a) as being unpatentable over Zhao in view of Dubin et al. (USPN 5,695,810, hereinafter "Dubin").

The dependent claims 5, 11, and 17 respectively depend from independent claims 1, 7, and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim nonobvious combinations thereof including the first and second barrier layers are of the same metallic barrier material.

More specifically, Applicants respectfully submit that absent a teaching suggesting that the material of the first and second barrier layers be the same, such a conclusion is not obvious. Absent some teaching, this conclusion then is an application of an "obvious to try" standard, which is an inappropriate standard of obviousness as indicated in *In re Lindell*, 385 F.2d 435, 155 USPQ 521 (C.C.P.A. 1967), which criticized this test.

"These are, perhaps, the obvious areas to try. But resulting inventions are not necessarily obvious. Serendipity is not a prerequisite to patentability. Our view is that "obvious to try" is not a sufficiently discriminatory test."

The dependent claims 6, 12, and 18 respectively depend from independent claims 1, 7, and 13, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim nonobvious combinations thereof including the first and second barrier layers have substantially the same thickness.

In particular, the Applicants respectfully submit that it would not have been obvious to modify Zhao in view of Dubin. The Examiner stated in the Office Action page 3, next to last paragraph, that:

“Zhao et al fails to express a particular thickness of the second barrier layer but refers to a particular application for deposition technique which is related to the Dubin et al patent which teaches forming said layers in the range of thickness as those discussed by Zhao et al with regard to the first barrier layer.”

Zhao Col. 10, lines 26-30, references Dubin, and discloses that the first barrier layer in Zhao is of approximate thickness of 100-1000 angstroms (Col. 8, lines 30-35), but Dubin does not teach forming a second barrier layer in the range of thickness as those discussed by Zhao for the first barrier layer. Dubin only discloses the composition and method of depositing a barrier layer and does not disclose the thickness to which a barrier layer should be formed. Therefore, both Zhao and Dubin fail to disclose the thickness of the second barrier layer.

Further, the first barrier layer in Zhao is “conformally deposited” (Col. 8, lines 19-21 and 36-38), while the second barrier layer in Zhao is selectively deposited (Col. 10, lines 18-20). Because the two barrier layers are deposited with different methods, in different places, and with different inherent problems, the Applicants respectfully submit that it would not be obvious to modify Zhao in view of Dubin to render the Applicants’ invention obvious.

The other references cited by the Examiner showing the prior art have been considered and are not believed to disclose, teach, or suggest, either singularly or in combination, Applicant’s invention as claimed: Wagganer (USPN 6,146,986); Joshi et al. (USPN 5,889,328); Nariman et al. (USPN 6,157,081), and Zheng et al. (USPN 5,705,849).

Conclusion

In view of the above, it is submitted that the claims are in condition for allowance and reconsideration of the rejections is respectfully requested. Allowance of claims 1-18 at an early date is solicited.

Serial No.: 09/663,021
Group Art Unit: 2815

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including any extension of time fees, to Deposit Account No. 01-0365 and please credit any excess fees to such deposit account.

Respectfully submitted,



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Date: July 29, 2002